Journal of the Royal Society of Western Australia, Vol. 66, Part 4, 1984, p. 147-162.

Vegetation of Yule Brook Reserve near Perth, Western Australia

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Manuscript received 18 October 1982; accepted 22 February 1983

Abstract

The Yule Brook reserve is a small block located 20 km S.E. from Perth (32°S115°W) in a climate of cool wet winters and hot dry summers. A clay flat is crossed by two parallel sand ridges.

The vegetation of the deep leached sand of the ridges is Banksia woodland on the crests with low shrub undergrowth continued on the treeless slopes.

The clay flats which have a shallow cover of sand and are waterlogged in winter and baked hard and dry in summer have a perennial cover of the rush type *Leptocarpus* interrupted by scattered low shrub mounds and saline depressions.

Slightly raised sections which still have some waterlogging in winter are dominated by the shrub *Leptospermum* or the conifer *Actinostrobus* in each case with a varied understorey of sedges and shrubs, semishrubs and herbs.

As a result of the extreme contrasts between the conditions in winter and summer the herbaceous flora is markedly seasonal with numerous geophytes and ephemerals. Of special interest are the many insectivorous plants *Drosera*, *Byblis*, *Utricularia* and *Polypompholyx*, and the "Trigger plants" *Stylidium* spp.

Altogether there are at least 370 indigenous species on the block, a large number for a block of less than 50 ha.

Introduction

The Yule Brook Reserve lies 20 km southeast from the centre of Perth (32°S 115°E) in a region of poorly-drained flats on the coastal plain at the foot of the Darling Scarp. One area of these flats, near Kenwick, has long been a favourite haunt of botanists because of the rich variety of unusual plant species found there. The former Government Botanist, the late Mr. C. A. Gardner for example, collected extensively in the region and Lloyd (1942), in his classic monograph on carnivorous plants, refers to it.

In 1949 the University of Western Australia purchased 34.6 ha of the "swamp region" for research and teaching purposes by members of its Botany Department. Known officially as the "Yule Brook Botany Reserve, Kenwick", but more commonly referred to by local botanists as "Cannington Swamp", the Reserve is listed in the Western Australian Government Gazette (9th November, 1979) because of its special nature. Consequently, no development of the Reserve is permitted without the approval of the Metropolitan Regional Planning Authority in addition to that of the local authority, the Gosnells City Council. The site is important as a remnant of natural swamp vegetation which is rapidly diminishing with urbanisation of the region.

The major portion of the Yule Brook Reserve was described and mapped and contoured in 1950 by the late Dr. N. H. Speck as part of a M.Sc. thesis (Speck 1952). Although his maps and descriptions of the plant communities are frequently used by staff and students of the Botany Department his work remains largely unpublished.

Since the original mapping, roads have been built (in 1961 and later) on two sides of the block, formerly only accessible from an early pipeline track (Bickley Road) along the south-western boundary. Drainage along the road verges, damage in the course of road building, and firebreaks put down and maintained since 1964 have somewhat reduced the communities mapped by Speck. Fires have been frequent and their impact is described in a second paper (Baird in prep.).

This general account of the vegetation is based primarily on Speck's work with some later observations. It is hoped that the paper will provide a background against which future changes can be assessed. A species list has been revised to incorporate some additions and many recent changes in nomenclature.

General Features of the Reserve

The Reserve site is distinctive within the general area of the swampy flats in that the flats are crossed diagonally by two parallel north-south sand ridges, the larger eastern one rising to 5-6 m above the flat while the smaller western one, which does not reach the north-west boundary, is less than 2 m. Both ridges rise steeply on the western side with a long, gradual slope to the east.

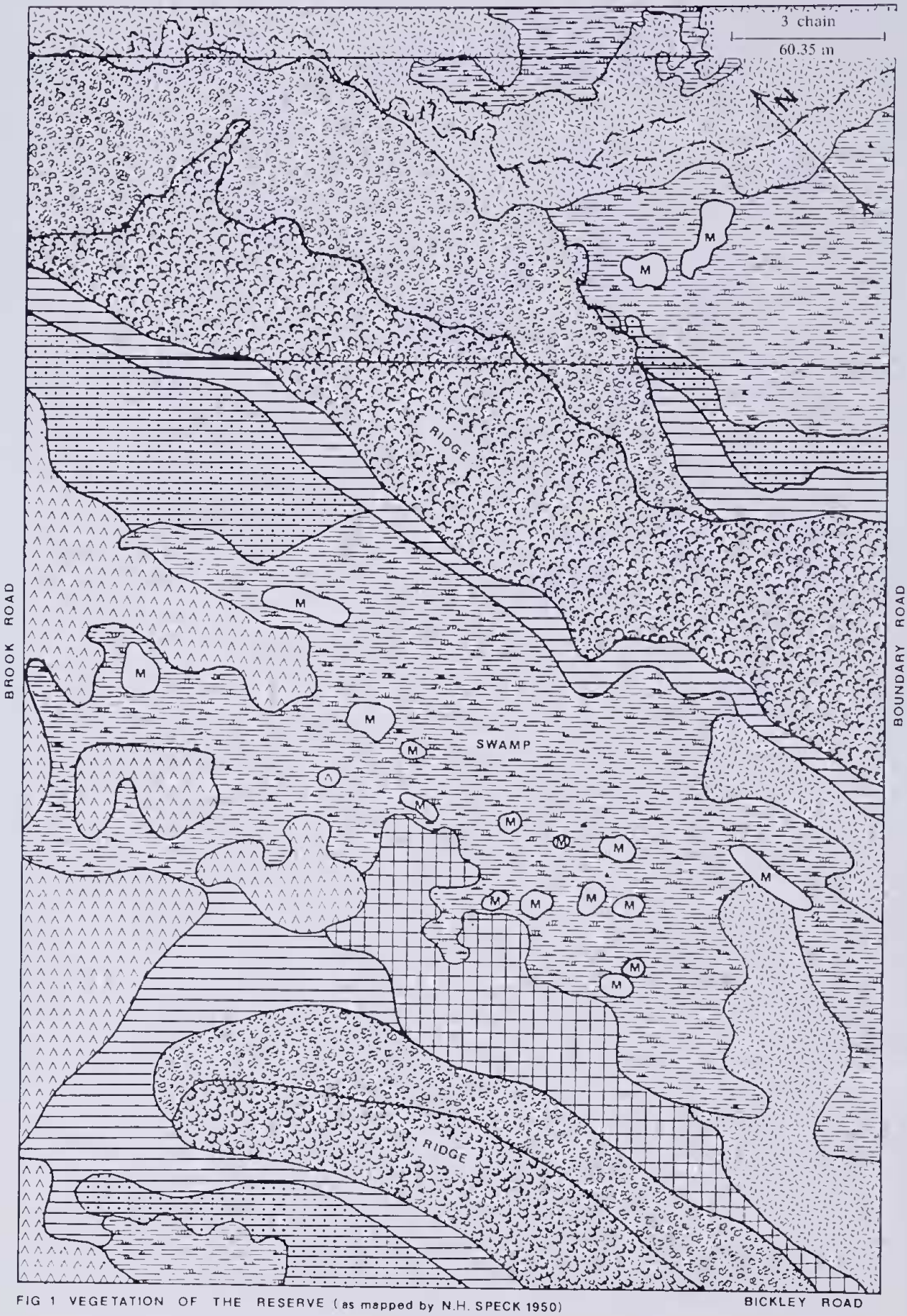

FIG 1 VEGETATION OF THE RESERVE (as mapped by N.H. SPECK 1950)

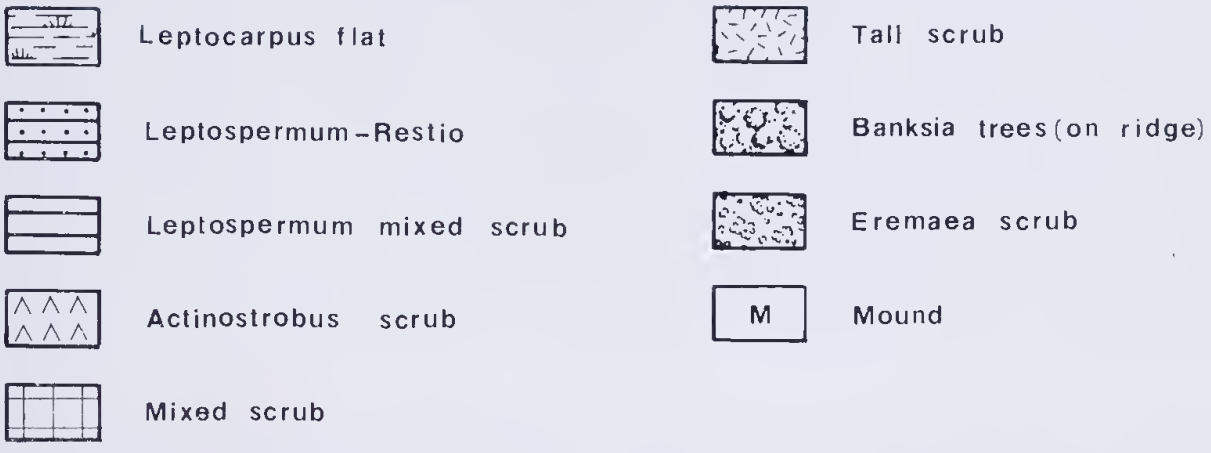

Figure 1.—Map of plant communities. This shows the communities recognised and mapped by N. H. Speck. The outlines were copied from his M.Sc. thesis 1952 with an extension at the north eastern end.

Drainage east of the main ridge is into a small tributary of Yule Brook, but over the main flat is very sluggish so that water lies on the surface for much of the winter. A poorly-defined drainage line meanders to the west.

There is evidence from a series of straight parallel lines on aerial photographs that a portion of the flat adjacent to the eastern ridge had once been cleared and cultivated—the spacing suggests viticulture, although this is unconfirmed. It has been known in its present uncultivated state since early in this century.

The soils are strongly-leached, whitish-grey siliceous sands overlying an undulating heavy yellowish clay. On the flats the sand varies between 10-45 cm, whereas on the ridges it may be several metres deep. In parts of the flats, calcareous particles occur in the subsoil, and some low lying parts are markedly saline. In sections at the foot of the ridges a greater organic content in the wet soil produces a humus podsol and at some lower levels of the ridges an accumulation of brown iron leachate known locally as 'coffee rock' occurs at the interface between sand and clay. Details of soil profiles are given in Appendix 1.

The climate is that of the Perth metropolitan region, i.e. one of cool, wet winters and long, hot, dry summers. Of the average annual rainfall of 883 mm, 70% falls in the four winter months May-August, and only 5% in the four summer months December-March. Conditions are made more extreme on the flats by waterlogging in winter and exposure to hot drying winds in summer.

The Plant Communities

There is a clear distinction between the wooded crests and shrub covered slopes of the well drained sand ridges and the predominantly rush covered flats, which are waterlogged in winter and have a rich ephemeral flora, most conspicuous as the water recedes in spring and early summer. Intermediate levels are complex and less readily classified. Figure 2 shows general views of the reserve.

Speck in 1949-50 mapped about two thirds of the area on a chain* square grid. His map is reproduced in Fig. 1. The map has been extended to include the remainder by sketching in approximately the most obvious boundaries using aerial photographs.

For the purposes of mapping, Speck was able to identify and delimit communities as listed below:—

on the flats

Leptocarpus aristatus meadow

Leptospermum ellipticum—Restio tremulus low scrub

Leptospermum ellipticum mixed scrub

Actinostrobus mixed tall scrub

on the ridges

Banksia low scrub woodland

Eremaea low scrub

The following description uses these community names even though they may not be consistent with later terminology (e.g. Specht 1970). The photographs have been selected to show samples of the communities shown on Speck's map (Fig. 1) which should be referred to.

The Leptocarpus aristatus meadow

The species is clearly dominant and in its best development forms a dense uniform sward up to 35 cm high with a distinctive pinkish brown colour given by the persistent flowering heads. It occurs on the flats between and beyond the ridges. The section on the western first flat on the map is small but it is cut off from the major part of this sward (Fig. 2A) by the long established Bickley Road. On the third flat to the south east of the higher eastern ridge the *Leptocarpus* occurs mostly as isolated tufts on bare white sand (Fig. 6B).

* 1 chain = 22 yards = 20.2048 metres; the chain was a standard surveyor's measure.

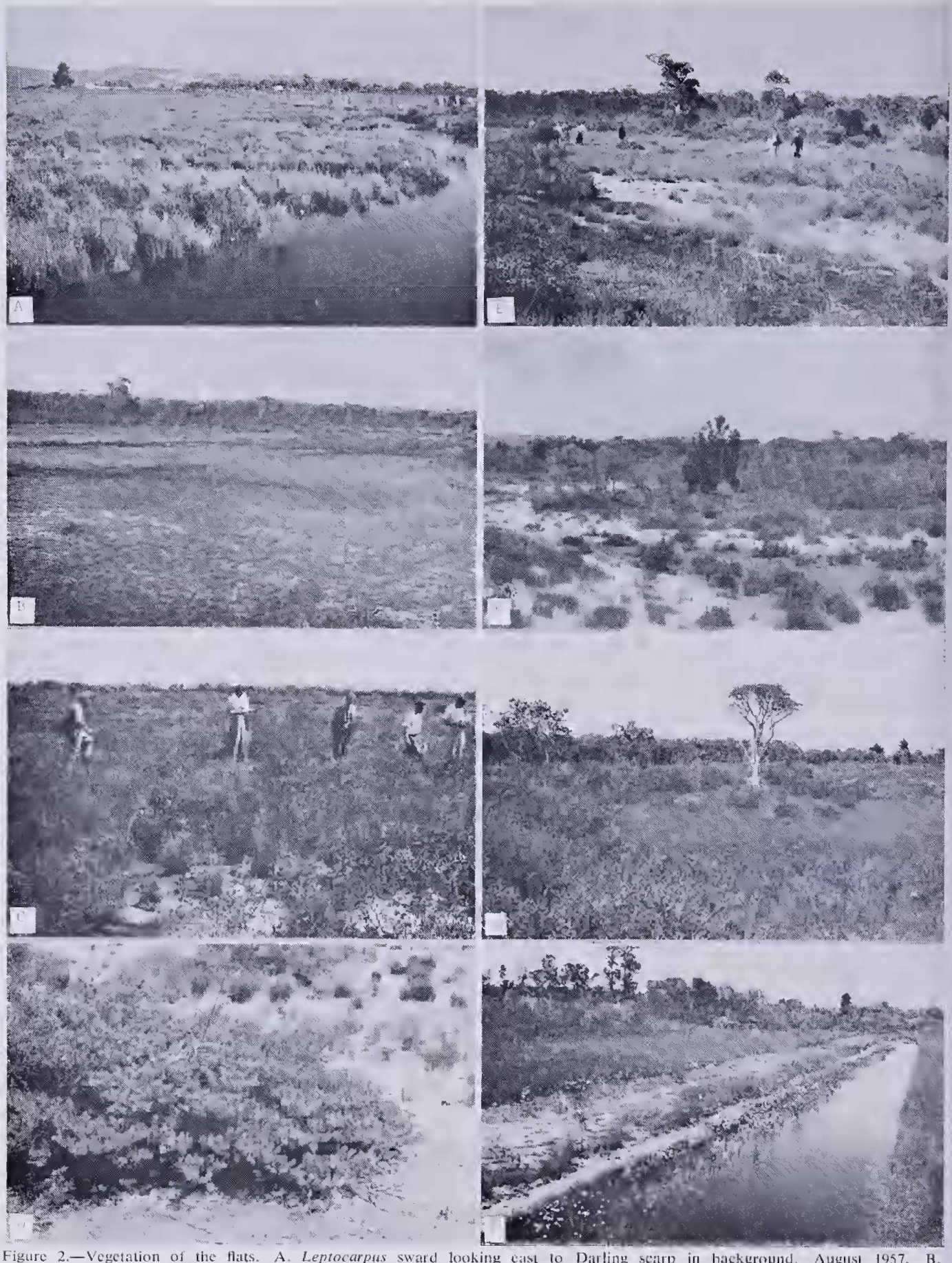

Figure 2.—Vegetation of the flats. A. *Leptocarpus* sward looking east to Darling scarp in background, August 1957. B. View across main flat to ridge. June 1970. Flat had been burnt in 1967. C. Part of the flat with numerous small bushes of *Banksia telmatiaea* and *Calothamnus villosus*. September 1955. D. A spreading bush of *Calothamnus villosus*. E. Flat at foot of ridge, depression with black mud and ephemerals in foreground, low mounds left and right, a tall paperbark *Melaleuca* (*M. preissiana*) on edge of ridge. September 1956. F. A broad spreading mound with central *Actinostrobus*, saline depression with *Halosarcia halocnemoides* right foreground. October 1959. G. Close to the tall *Melaleuca preissiana* in figure B, *Leptocarpus* flat and shrub covered slope to woodland, *Banksia littoralis* left skyline. September 1955. H. Looking along the flat where a scraped firebreak was put down in 1964 providing deeper water and a raised sandy rim; *Utricularia inaequalis* in water *Tribonanthes* on sand *Drosera gigantea* right hand corner. October 1965.

The most extensive area of flat lies between the two ridges (Fig. 2B). The sward of *Leptocarpus* is interrupted by an occasional isolated shrub of *Hakea varia, Melaleuca bracteosa (M. fasciculiflora)* or *Calothamus villosus* (Fig. 2D). In places nearer the ridge, shrubs, including *Banksia telmatiaea (B. sphaerocarpa)* are more abundant (Fig. 2C). In some depressed parts *Leptocarpus canus* (Fig. 4E) replaces *Leptocarpus aristatus*.

Scattered unevenly through the flats are mounds (Fig. 2 E and F) which are initiated by the accumulation of drifting sand against low spreading *Melaleuca bracteosa bushes*. The mounds vary from a single shrub with a few small associates to extensive mounds with an assortment of other shrubs surrounding the *Melaleuca* and sometimes including a tall *Actinostrobus* (Fig. 2F).

Saline depressions with *Halosarcia (Arthrocnemum) halocnemoides* (Fig. 2F) throughout the flats. Small depressions may have only a single plant, larger ones a group of the samphires, in some cases with a fringe of *Selenothamnus (Plagianthus) squamatus* a species slightly less salt tolerant than *Halosarcia*.

A small colony of *Wilsonia backhousei*, occurs in a wet saline depression on the south eastern extension of the reserve.

The soil of the *Leptocarpus* flats consists of heavy domed clay covered by white sand of varying depth. (Fig. 3 and Profile appendix 1.) This is a habitat of extremes. Water lies on the surface of the flats through much of the winter and gradually evaporates through spring and early summer. In summer the flats are hot and dry and windswept, consequently the herbaceous flora is markedly seasonal.

From soon after the first rains some species can be found growing and flowering, e.g. *Drosera bulbosa* in May. *Ultricularia menziesii*, a tiny rosette perennial with a single long-tubed scarlet flower, *Drosera heterophylla* and the sweet scented orchid *Thelymitra antennifera* are blooming through winter on the open flats. Where water is deeper *Polypompholyx multifidia* (Fig. 4A) and the smaller and less common *P. tenellus* and *Utricularia violacea* are in flower between August and October and slightly later the purple *Utricularia hookeri*. This species is most abundant at the western foot of the ridges where seepage from the sandy slope provides longer lasting water. It is associated here with the branched sundew *Drosera gigantea* (Fig. 4B). A graded firebreak (Fig. 2H) cut through this zone in 1964 provided a new habitat for the *Utricularia*.

The peak flowering period for herbaceous geophytes occurs through August-September with *Tribonanthes variabilis* (Fig. 4C), *Burchardia multiflora*, and many orchids (e.g. *Diuris* spp.) and sundews (*Drosera* spp.) conspicious. Also flowering in spring are the "ephemeral geophytes" such as *Utricularia menziesii, Drosera palaecea, Stylidium pulchellum* and the lycopod *Phylloglossum drummondii*. The fringes of the mounds provide a particularly favourable habitat for many of the herbaceous species.

Figure 3.—A spadeful of soil from the main flat showing the clear boundary between the sand and the underlying domed clay. May 1967. The flat had been burnt January 1967.

Most of the common annuals flower later than the perennials, usually in October-November. Members of the Asteraceae e.g. *Brachycome pusilla* (Fig. 4E) *Angianthus spp.*, (Fig. 4D, F) and many small ephemerals flower over a short period and die away as the surface soil dries out. Among the most abundant of these species is the inconspicuous *Centolepis aristatus*, but species of *Hydrocotyle, Calandrinia, Aphelia* and tiny annual species of *Stylidium* are also common. The black surface of saline depressions is often densely covered with *Angiathus strictus* (Fig. 4F).

Over the summer the flats are bare of herbaceous plants, and where the *Leptocarpus* cover is sparse (or absent) the sand is moved by small "willy willies", airwhirls which tend to remove loose sand from the bare areas and pile it up against the mounds.

It is probable that these flats, although remaining basically stable show a good deal of instability in surface detail. Slight changes in drainage or

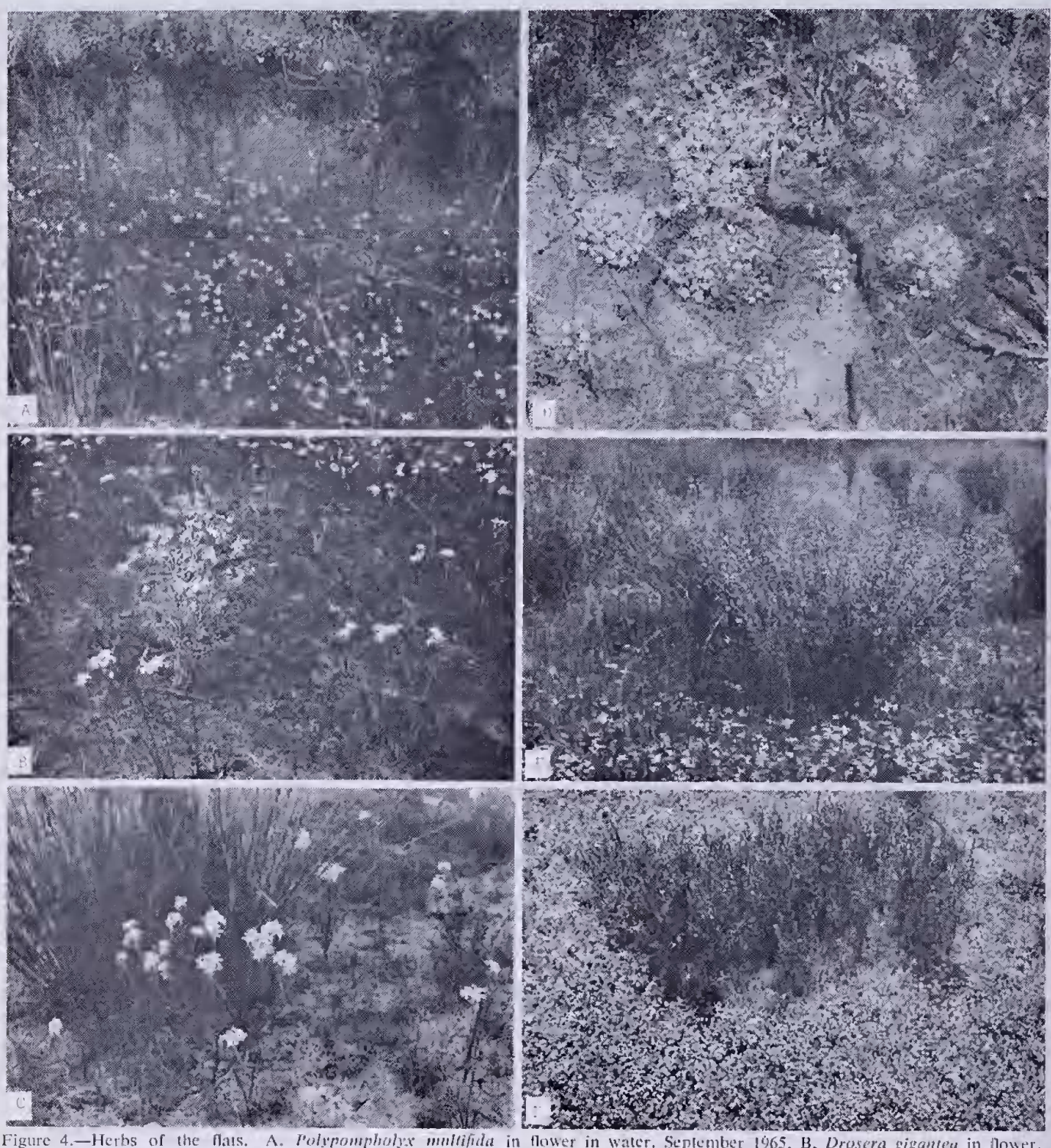

Figure 4.—Herbs of the flats. A. *Polypompholyx multifida* in flower in water. September 1965, B. *Drosera gigantea* in flower. C. *Tribonanthes variabilis* in front of a clump of *Gahnia trifida*. D. *Angianthus humifusis*. December 1st 1964. E. *Brachycombe pusilla* in front of clumps of *Leptocarpus canus*. October 29th 1975. F. Dense cover of *Angianthus strictus* in a saline depression with *Halosarcia halocnemoides*. October 29th 1975.

differences in annual rainfall in different years may vary the distribution and abundance of annual species. For example in the particularly dry year of 1959 no *Utricularia hookeri* was found in flower although it was present in its usual profusion in the following year. Loneragan (1973) has demonstrated marked fluctuations in numbers and distribution pattern of the geophyte *Tribonanthes variabilis*.

At the intermediate levels between the waterlogged flats and the sandy ridges the vegetation is perhaps at its richest and most varied, but it is also more difficult to classify. Speck recognised three communities:

Leptospermum ellipticum—Restio trenulus low scrub

Leptospermum ellipticum mixed scrub

Actinostrobus tall scrub

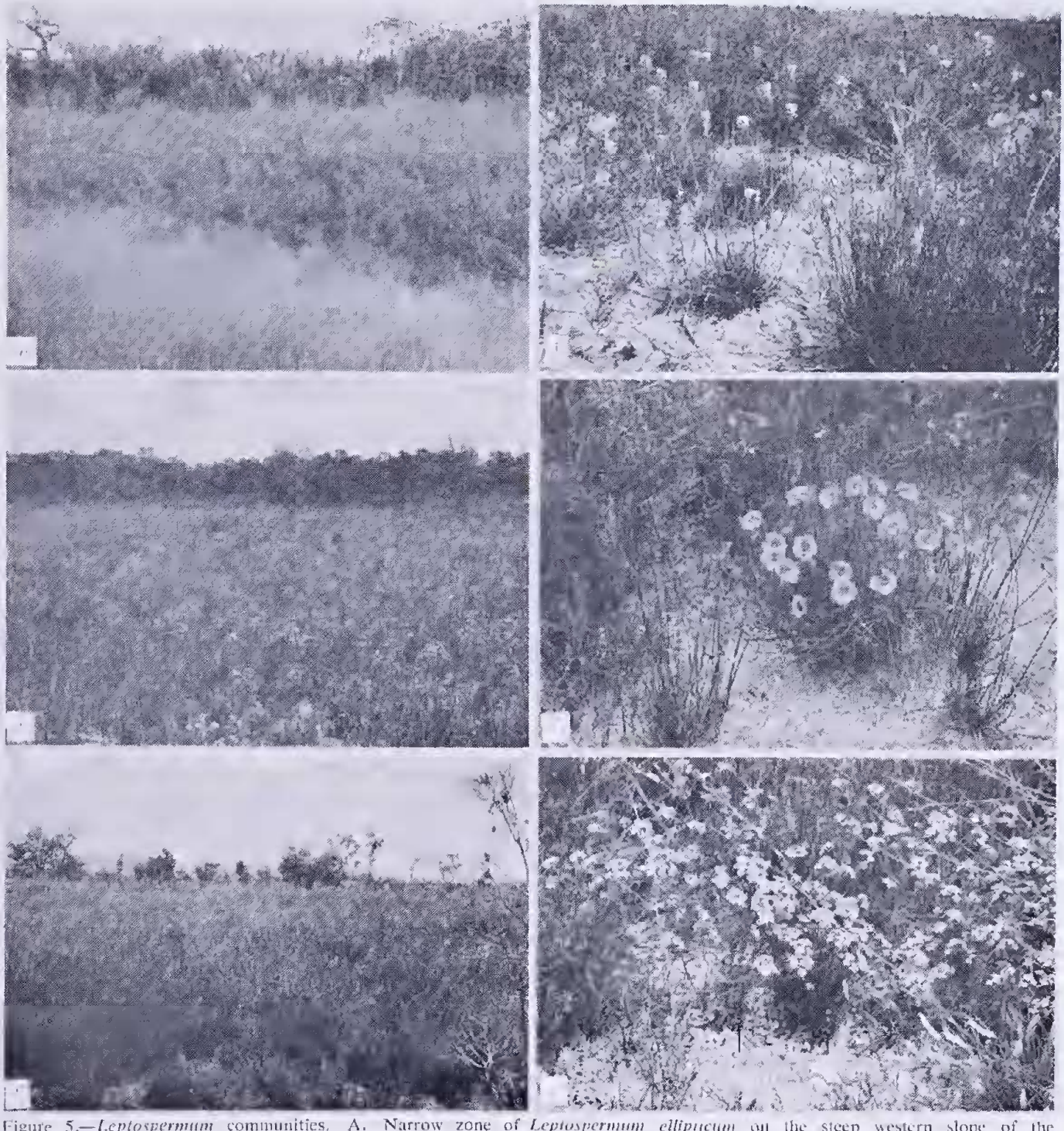

Figure 5.—*Leptospermum* communities. A. Narrow zone of *Leptospermum ellipticum* on the steep western slope of the eastern ridge, *Leptocarpus* sward in foreground, *Adenanthos* shrubs behind *Leptospermum*, *Nuytsia* projecting on left skyline. October 31st 1968. B. Broad zone of *Restio* and *Leptospermum* (in flower) eastern slope, *Banksia* woodland in background. October 31st 1968. C. Very gradual slope up to northern end of low western ridge. Dense low scrub of *Restio*, *Leptospermum*, *Banksia telmatiaea*, *Nuytsia floribunda* and slender *Eucalyptus calophylla* on the skyline. *Leptocarpus* in foreground. October 1965. D. *Conospermum huegelii* in flower on firebreak, dense mixed scrub behind. September 18th 1977. E. *Byblis gigantea* in flower. November 5th 1970. F. *Lechenaultia expansa* in flower, *Johnsonia* sp. left corner. October 31st 1968.

Leptospermum ellipticum—Restio tremulus low scrub

This is a clearly defined community with usually a sharp boundary where adjacent to the *Leptocarpus* meadow (Fig. 5A) made even more conspicuous when the *Leptospermum* is in flower. The two species *Leptospermum* and *Restio* are codominant although in old stands the *Leptospermum* may grow above and conceal the *Restio* (Fig. 5A).

Where the ridge rises steeply on the western slopes there is a narrow zone of *Leptospermum-Restio* with an upper rim of *Leptospermum* without *Restio* (Fig. 5A); where, as towards the northern end of both ridges, there is a fairly extensive shelf just above the main level of the flat but still waterlogged in winter a wide *Leptospermum-Restio* (Fig. 5B) community is particularly rich, with a

great variety of other swamp tolerant species. Common shrub species included are *Banksia telmatiaea, Hakea ceratophylla, H. sulcata, Calothamnus villosus,* the semishrubs *Conospermum huegelii* (Fig. 5D), *Conostylis filifolius, Leschenaul ia expansa* (Fig. 5F), *Petrophile longifolia* and many different sedges and rushes, for example, *Cyathochaeta avenacea, Schoenus* spp.. and *Anarthria gracilis.*

The seasonal herbaceous flora is again rich and varied with the insectivorous *Byblis gigantea* (Fig. 5E) and *Drosera neesii* common, with *Anigozanthos viridis, Stylidium* spp. and many of the herbs of the *Leptocarpus* flats previously listed.

Compared to the soils of the flats, the soil here contains a greater quantity of organic matter and is more a humus podsol with a tendency to coffee rock formation (see profile B west of first ridge and profile 2 west of main ridge, Appendix 1.).

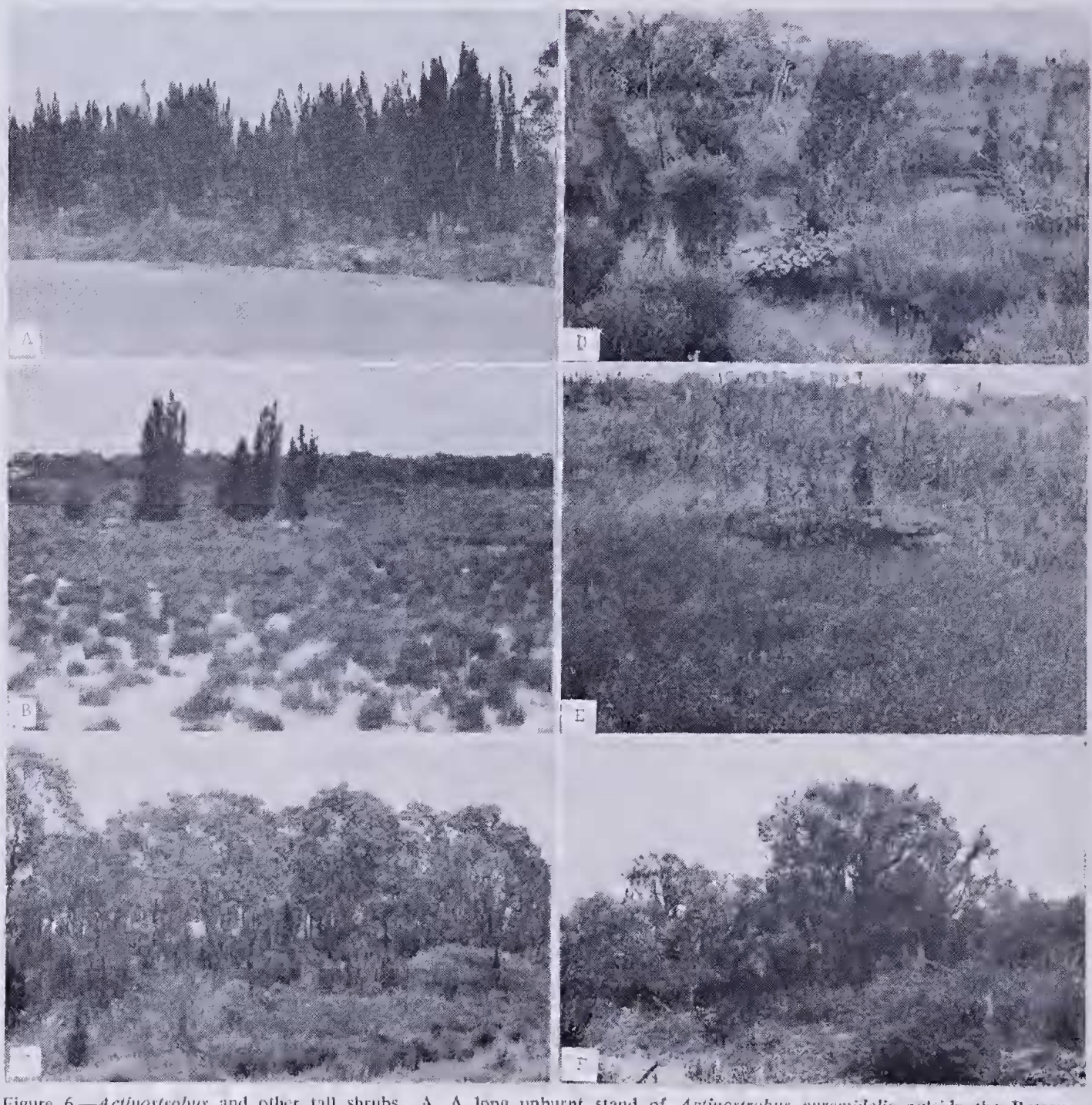

Figure 6.—*Actinostrobus* and other tall shrubs. A. A long unburnt stand of *Actinostrobus pyramidalis* outside the Reserve, November 1971. B. Tall *Actinostrobus* on the edge of the rise from the 3rd flat, *Leptocarpus* in foreground. October 1968. C. Young *Actinostrobus* growing under a stand of marri adjacent to the *Actinostrobus* of A. D. A mixed wet area. *Actinostrobus* centre, *Leptocarpus canus* foreground, *Viminaria* background right, *Melaleuca* background left. 23rd August 1956. E. Corner of the western flat, *Leptocarpus aristatus* foreground, prostrate *Calothamnus* with erect young *Actinostrobus, Viminaria* background. 9th December 1969. F. *Melaleuca rhaphiophylla* in flower on edge or creek, eastern boundary of reserve. 31st October 1968.

Leptospermum ellipticum mixed scrub

As the ground slopes up onto the ridge the *Leptospermum* increases in height, *Restio* gradually disappears, and new species appear with many of those from the lower zone. In Speck's description, "there is no sharp floristic boundary between the two *Leptospermum* zones, the change is one of structure; on the better drained and rising ground the *Leptospermum* increases to almost twice its height in the lower one and this is also true for other species." The mixed *Leptospermum* scrub grades from the lower *Leptospermum-Restio* and it is only where the changes in slope are sudden that a definite boundary can be recognised. Nevertheless, there is on both sides of the ridges this zone of dense scrub of variable composition but containing species which do not occur further up the ridges. The more abundant shrubs here include *Banksia telmatiaea, Beaufortia squarrosa, Daviesia incrassata, Euchilopsis linearis* and *Hypocalymma angustifolium,* and in some parts, *Astartea fascicularis* or *Regelia ciliata.* Of these species *Banksia telmatiaea* (Fig. 7C) has a greater vertical range than most, extending from the *Leptocarpus* flats to beyond the uppermost *Leptospermum.* A few specimens of *Melaleuca preissiana* (old man paperbark, Fig., 2G) and *Banksia littoralis* (swamp banksia) also occur at this level and, although this is not its best habitat, several small trees of *Eucalyptus calophylla* (marri) (Figs. 2H, 6C). In the long unburnt southeastern slope of the main ridge this scrub developed into a dense thicket 1.5-2.0 m tall with *Banksia telmatiaea, Beaufortia squarrosa, Daviesia incrassata* and *Hakea varia* as the principle components.

The soil, as for the lower zone, is a humus podsol but as this zone is higher up the ridge than the *Leptospermum-Restio*, the sand is deeper above the water level. The coffee rock layer is better developed here than in any other soil of the reserve (profile C, Appendix 1).

Mixed low scrub

Towards the south eastern section at the foot of the low ridge the Leptospermum dominated community of the northwestern end is replaced by a mixed assemblage of low shrubs in which the mound building *Melaleuca bracteosa* is conspicuous with *Hakea varia, Banksia telmatiaea, Verticordia spp.* and other shrubs and herbs some indicating lime in the soil eg. *Grevillea thelemanniana* and *Acanthocarpus. Acacia lasiantha* is abundant, particularly after fires. All these plants belong to species present in adjacent communities, but form a somewhat distinct grouping. Speck outlined the area on the map as mixed low scrub.

Actinostrobus pyramidalis tall scrub

Because of the characteristic conifer habit and dark foliage *Actinostrobus* communities (Fig. 6) are easily recognised and can be mapped on the basis of the presence of the species. At its best it forms almost a miniature conifer forest with slender crowded small trees. One such stand (Fig. 6A) occurs adjacent to the reserve and, in contact with this, young plants were growing under marri (Fig. 6C). Tall plants on the edge of the eastern flat are shown in Figure 6B.

Most stands on the reserve have scattered *Actinostrobus* associated with some of the shrubs of the *Leptospermum* zones *Hypocalymma angustifolium* is particularly common, other species are *Melaleuca lateritia, Beaufortia squarrosa, Leptospermum ellipticum, Kunzea micrantha, Verticordia* spp., *Andersonia aristata, Conostylus* spp., *Restio* spp. and a wealth of seasonal herbaceous species, *Stackhousia huegelii, Philydrella pygmaea, Brachycome pusilla* (Fig 4E) and others. *Isoetes* is sometimes found growing in black mud in water filled depressions often but not invariably near *Actinostrobus* or *Viminaria.* Although *Actinostrobus* stands are at approximately the same contour level as the *Leptospermum-Restio* the soil contains less humus, and the underlying clay has a high pH and usually contains calcarous nodules.

A new road and parallel firebreak cut through the *Actinostrobus* stands on the north west side of the block have considerably reduced the area shown in Speck's map, and repeated fires have prevented the development of tall stands. Near the north-eastern corner of the reserve a few trees have escaped fire and reached an age of some 160 years as shown by ring counts (Loneragan pers. com.).

Viminaria juncea, a tall broom-like legume dominates big areas of swampy flats in the district which have clay at the surface. It has spongy pneumatophores which project up through the water covered clay from horizontal roots. On the Reserve where most of the clay is covered by sand there are no extensive suitable habitats and the occurrences are too scattered to justify separate mapping. Speck simply mentions it as occurring in some of the *Leptospermum-Restio* and *Actinostrobus* areas. It is shown in figures 6D and 6E.

Fringing thickets of tall shrubs

Dense thickets of tall shrubs, mainly species of *Melaleuca, M. rhaphiophylla* (paperbark) (Fig. 6F); *M. uncinata, M. viminea, M. cuticularis,* border the small creek (more a swamp at its southern end) on the eastern boundary of the reserve. Another group of paperbarks occurs along a drainage line in the south western extension across Bickley Road and there is a deeper paperbark swamp near the corner of Bickley and Boundary Roads in an adjacent property.

Banksia woodland

On the crest of the ridge is a low woodland (Fig. 7A, B) of *Banksia attenuata* and *Banksia menziesii* with a few trees of *Casuarina fraseriana* and still fewer of *Banksia ilicifolia.* The slope up to the dense banksias in the background is shown in Figure 7C. The undergrowth is a low shrub layer with a high percentage of harsh perennial monocotyleons. The community is representative of the vegetation of the poor leached sands of much of the coastal plain. Here as with most South-West Australian vegetation dominance of a type of small-leaved sclerophyllous shrub is the pattern rather than dominance of any one species. Common dicotyledons are *Hibbertia* spp., *Hovea trisperma, Bossiaea eriocarpa, Acacia pulchella, Jacksonia flori-*

bunda, Leucopogon spp., *Astroloma* spp., *Dampiera linearis* and many others. Common Monocotyledons are *Xanthorrhoea priessii, Conostylis* spp., *Patersonia occidentalis, Amphipogon turbinatus.* The tall grey foliaged shrub, *Adenanthos cygnorum* (Fig. 7D) in places forms a conspicuous zone fringing the Banksias. Scattered *Nuytsia floribunda* (Christmas tree) trees occur beyond the boundaries of the Banksias on the slopes of both ridges (Figs 5A & C). The small stand of Banksia on the low western ridge was cleared illegally about 1954 and has not regenerated.

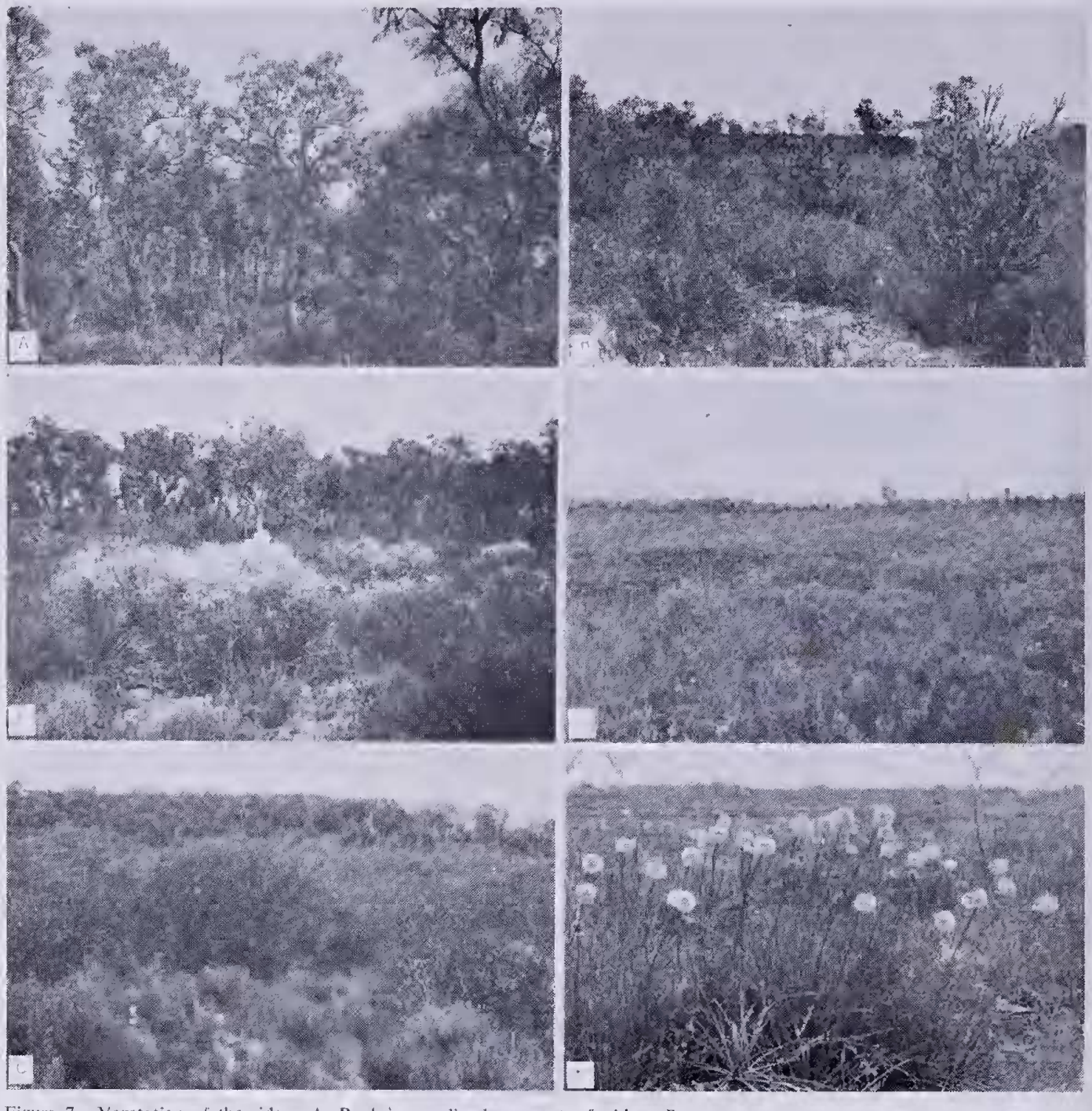

Figure 7.—Vegetation of the ridge. A. Banksia woodland on crest of ridge, *B. attenuata* centre and left edge, *B. menziesii* left of centre, *Casuarina fraseriana* overhanging right corner, low shrub undergrowth. September 19th 1977. B. *Conospermum stoechadis* in flower on eastern slope. September 19th 1977. C. Part of slope up to dense woodland, *Adenanthos* in front of Banksias, rounded bushes of *Banksia telmatiaea* on edge of slope behind *Leptocarpus.* October 29th 1975. D. Shrub cover on upper slope of ridge, *Adenanthos cygnorum* (tall shrub), *Eremaea pauciflora* low rounded shrub centre on edge of firebreak, *Xanthorrhoea* left. October 26th 1965. E. View along eastern slope of ridge with dense low shrub cover. December 9th 1969. F. *Dasypogon bromeliifolius* in flower on eastern slope of low western ridge. October 1959.

Eremaea low scrub

The shrub community of the slopes is continuous with the undergrowth of the woodland but in the open is denser with a higher proportion of larger species. *Eremaea pauciflora,* a compact spreading microphyllus shrub, is particularly conspicuous in late spring with its massed orange flowers. On the first ridge it is sufficiently abundant to justify Speck's giving its name to the community but there are many associated shrub species. The monocotyledons, *Dasypogon bromeliifolius* (Fig. 7F), *Lyginia barbata, Schoenus curvifolius, Anigozanthos humilis, Loxocarya fasciculata,* and *Calectasia cyanea* are also abundant. Since the clearing of the Banksias this low scrub continues right across the ridge.

On the extensive eastern slope of the main ridge (Fig. 7E) the shrub community is richer and more diversified and *Eremaea* though abundant is only one of several conspicuous shrubs. *Casuarina humilis* forms bulky cover in places and there is a stand of *Conospermum* sp. (Fig. 7B), very conspicuous when in flower, at a mid level on the slope. *Jacksonia floribunda* is common throughout, its flowering shoots projecting above the general level. However, the main character is the large number of species of low shrubs and semi-shrubs, and fibrous or shrubby monocotyledons. At least eighty species in these categories have been recorded on the ridges and there are also seasonal herbaceous plants.

At the northern part the slope goes down to a small creek meandering along the eastern boundary. At the southern end it goes through the series of *Leptospermum* scrubs to the third *Leptocarpus* flat (Fig. 6B).

There is a gradual change in species composition down the slopes with some not very clear zoning—for instance *Jacksonia furcellata* grows on the lower slopes of both ridges *Jacksonia floribunda* right across the upper levels. *Xanthorrhoea* is more abundant at lower levels. On the lower parts of the low ridge, *Eremaea* is replaced by another myrtaceous shrub of similar habit, *Melaleuca seriata,* before the more definite *Leptospermum zone* is reached.

Flowering on the ridges extends from soon after the first winter rains into late summer but as on the flats with a marked spring maximum. Undershrub species which have their buds formed the previous season eg. *Acacia stenoptera* and several epacrids are the first to bloom followed by *Hovea, Daveisia, Hibbertia, Bossiaea* and others some with flowering extending over several months (eg. *Hibbertia hypercoides). Eremaea, Jacksonia* and *Adenanthos* are slightly later. The tree species of Banksia supply flowers throughout the year *B. menziesii* and *B. Littoralis* autumn-winter; B. attenuata spring-summer. Flowering of seasonal herbaceous species is also spread but with each species lasting a shorter time as illustrated in the orchids. As on the flats annuals are in general later than geophytes.

Tall scrub

A strip along the southeastern side between the ridges was mapped by Speck as tall scrub but with some doubts as to its status. This is a disturbed area crossed by old tracks, with uneven ground and numerous weeds. The tall species remaining are *Kunzea vestita,* several species of *Melaleuca,* some *Actinostrobus, Adenanthos* and abundant *Acacia saligna,* a species which often increases on disturbed ground as seen also along the road-verges to the northwest of the Reserve. The profile is very uneven but some bushes reach a height of 3-4 metres.

Flora

The Flora of the sand ridges is as found in Banksia woodlands on poor leached sand in other parts of the coastal plain. It consists of representatives of the characteristics south-west families and genera, for example Proteaceae (8 spp.) Paplionaceae (10) Myrtaceae (8) Epacridaceae (8) Dilleniaceae (3) Liliaceae (6) Xanthorrhoeaceae (16) Haemodoraceae (7), orchids and a few grasses and annual composites.

The flora of the varied levels of the wet flats is much more diverse and unusual containing a large number of species of specialised wet habitats, many of exceptional botanical interest. *Actinostrobus* is an endemic W.A. conifer restricted to certain types of swamp which although widely scattered are becoming reduced by clearing. *Phylloglossum* is a highly specialised Lycopod. There are no true ferns.

Insectivorous plants are particularly well represented with five species of rooted bladderworts; three of *Utricularia* and two of *Polypompholyx; Byblis gigantea,* (rainbow plant); six species of *Drosera* (sundews) on the flats and others on the ridges. Another genus of special interest is *Stylidium* the "trigger plants" with their sensitive column involved in insect pollination. There are at least 20 species including those on the ridges.

Small geophytes and annuals belonging to many different genera and families from Centrolepidaceae to Asteraceae (Compositae) and Apiaceae (Umbelliferae) as seen in the species list are found on the flats.

As usual in swampy ground there are many sedge and rush types Cyperaceae (9-10 spp.) Restionaceae (10) and a few Juncaceae.

Among shrubs on the wet flats Myrtaceae (± 20) are numerous with ten species of *Melaleuca* and six of *Verticordia.* Proteaceae are represtend by Hakea (4), Grevillea (1), Petrophile (2) and Conospermum (1) and there are several semi herbaceous Goodeniacaeae.

The total indigenous flora of the reserve numbers at least 370 species in 52 families of which Dicotyledons number 39 families, 113 genera and 226 species, and Monocotyledons 13 families with 62 genera and 142 species; 1 Conifer, 1 Cycad, 3 Pteridophytes.

Aliens

Introduced plants have not been included in the species list. Many common metropolitan weeds have occurred on parts of the site since long before it was a botanical reserve, e.g. *Romulea rosea, Briza maxima* and other grasses and medics, *Ursinea anthemoides* (on the ridge) and other annuals. *Parentucellia viscosa* and *Dittrichia graveolans* are well established on the western ridge. Recently more aggressive

weeds have heen invading from the road verges: e.g. *Watsonia pyramidata, Gladiolus caryophyllaceus* and other bulbous spccies mainly of South African origin. The perennial veld grass *Ehrharta calycina* is a more recent invader. Monitoring the spread of weeds could be a project for the future.

Bryophytes have not been listed. This would he better done for a much wider area. The habitat of the reserve with most of the surface loose sand is unfavourable for liverworts which however do form a surface cover in parts of the regional flats where the surface is a clay loam. On the reserve there are moss cushions in the shelter of hushes on some of the old established mounds and small isolated occurences of liverworts.

Discussion

This paper gives a general idea of the topography of the reserve, types of vegetation and species present. The vegetation has been described under community types. In a situation such as this where habitat differences arc marked as betwecn well drained sandy ridges and waterlogged flats there is a distinct assemblage of species tolerant of each condition, and as the change in physical gradient is steep the ecotone is narrow. Furthermore where there are clear dominants as in the *Leptocarpus* and *Leptospermum* and *Actinostrobus* zones it is possible to draw boundaries based on the boundaries of these species, although the continuum concept may apply if all species are considered. On the long gradual slopes with many species but none clearly dominant there are slight gradients in species distribution but the same type of low shrub vegetation with many species so that the whole slope can be classed as one community.

Although the flats are clearly dominated by the *Leptocarpus* sward there is on thc flats a mosaic pattern of minor species which results from small habitat d.fferences; e.g. slight difference in level, exposure of clay at the surfacc, amount of humus, presence of underlying calcareous nodules, and slight differences in salinity apart from the well defined saline depressions with *Halosarcia*.

Noteworihy in all of the wetlands and to a lesser extent on the sand ridges is the larger number of herbaceous geophytes including some tiny "ephemeral geophytes". In the valuable study by Pate and Dixon (1981) of the bulbous, cormous and tuberous plants of W.A. no fewer than 50 of the species occurring in the Southwest occur on the small Yule Brook Reserve. Some have been studied in detail; morphology and growth of underground organs and changes in chemical resources through the seasons, thus increasing understanding of the methods of survival and rcproduction in the difficult environment.

In addition to the herbaceous geophytes there are the many wiry rhizomatous plants which do not die down in summer but have the geophyte character of protected underground growing apices.

Changes in thc vegetation and habitat since 1950 are difficult to assess as no quantitative records have been kept until recently. Part of the *Actinostrobus* stands was totally removed by the road put down in 1961 and firebreaks have cut into all communities near the boundaries and at the foot of the ridges. The effect of drains along the roads does not appear to extend far into the block. Unt.l a few wet seasons follow the long drought (1975, 6, 7) it is difficult to say whether changed drainage or drought is responsible for the flats being drier and more saline than previously remembered. It remains to be seen whether this is continuing or reversible.

An invasion by aggressive weeds from road verges is an obvious change, and with increased traffic, including earth carrying trucks, the chances of fresh introductions are increasing.

The influence of fire will be discussed in a second paper.

The site has a long history of involvement in botanical studies: taxonomic collections and descriptions over many years by government botanists and others and specialised studies such as *Actinostrobus* Saxton 1913, Baird 1937) insectivorous plants (Lloyd 1942), *Phylloglossum* (Hackney 1950), and recently *Viminaria, Cyathochaeta, Hakea sulcata* (Lamont 1972, 1974, 1976), *Tribonathes* (Loneragan 1973), Pate and Dixon 1981, Goble-Garrett, Bell and Loneragan 1981). Many detailed studies are in progress and the reserve should provide research opportunities for many years. The fact that it is close to the city makes it particularly useful for student work and it is hoped that any deterioration of the site will continue to be slow as it appears to have been to date.

Acknowledgements.—The contribution of the late N. H. Sreck is acknowledged in the use of his name as co-author. My notes have heen made intermittently over many years in association with other members of the Botany Department of the University and student classes. My thanks are due to the several memhers of staff who know the reserve and have read the manuscript and offered suggestions; also to those of the staff of the Western Australian Herbarium who have checked the species list. To all of these I am deeply grateful. I have to thank Mr W. M. McArthur for a set of soil profiles. Thanks also to Mr Miller of the Geography department for preparing the map for publication and to Mr Martin Lucks of Botany for mounting and photographing the figures for publication.

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Appendix I

Soil Profiles of Yule Brook Reserve

Note:—Profiles 1-4 were taken by W. M. McArthur in 1981 on the central swamp flat, adjacent slightly raised areas and on the main sand ridge, all towards the north western side of the block.
Profiles A-F are from N. H. Speck's thesis and were taken in 1950 in a series from the swamp flat at Bickley road to the top and eastern slope of the low sand ridge.

1. *Leptocarpus Zone*

Flat landscape with evidence of salt (NaCl) on the surface and a Solonetz profile (or a strong texture-contrast profile).

0-5 cm	Grey-brown coarse sand.
5-40 cm	Very light grey coarse sand.
40-60 cm	Dull olive brown sandy clay with faint greenish-grey moles. The clay is markedly domed with organic staining on the surface of the domes. Some ferruginous concretions (0.5 cm diam).
60 cm	Ferruginous hard pan.

2. *Leptospermum Zone* Flat landscape

Soil profile is a *humus podzol* with following description:—

0-5 cm	Dark grey-brown coarse sand.
5-30 cm	Light grey coarse sand.
30-60 cm	Very light grey-brown coarse sand.
60 cm	Black indurated organic pan.

3. *Banksia Community on Main Sand Ridge*

The soil is composed of almost white coarse silicious sand which shows no profile differentiation other than organic staining in the surface. The sand may be 6 m deep overlying a clay substrate. There is a surface layer of decomposing organic matter. The profile on the treeless lower slopes of the ridge is similar but is not so deep.

4. *Actinostrobus Zone*

Flat or slightly hummocky landscape, slightly elevated above the *Leptocarpus* Zone—and with a Solonetzic Profile.

0-5 cm	Grey coarse sand.
5-70 cm	Very light grey sand.
70-100 cm	Yellow brown to greenish mottled sandy clay.
100-120 cm	Olive brown sandy clay with soft lime and some limestone nodules pH 8.0.

Profile A. *Leptocarpus aristatus* community on first flat.

Horizon	Depth (cm)	General Description
A0	—	Very little litter.
A1	2-8	Light grey with little organic material pH 7.0.
A2	8-12	Very light grey sand—showing signs of leaching.
	12-35	Very leached white sand.
B	35	Dull yellow sandy clay.
	60-75	Black, gritty nodules appear in the clay.
	75-100	Clay becomes purer and deep yellow.
	100-150	Very sticky bright yellow and blue mottled clay.
	165	Calcareous particles pH 9.0.

Profile B. *Leptospermum-Restio community* at base of first rise.

Horizon	Depth (cm)	General Description
A0		Considerable litter.
A1	0-15	Very dark grey sand, black when wet and considerable organic matter pH 5.
	15-60	Leached light grey sand
B1	60	Sand begins to darken and develops rapidly into a brownish hardpan.
	75-90	Dark brown coffee rock—but is very clayey. Shows definite columnar jointing during the summer.
	90-165	Clay of a light brown colour and with a few black nodules (as similar horizon in Profile A).
	170	Hard white layer of calcareous material pH 8.

Profile C. *Leptospermum-Banksia sphaerocarpa* Community.

Horizon	Depth (cm)	General Description
A0		Abundant litter.
A1	0-12	Very dark grey sand, black if wet; contains abundant organic matter pH 5.0.
	12-20	Light grey sand showing signs of leaching.
	20-90	Leached grey-white sand.
	90+	Very thick hard dark brown coffee rock pH 4.5.

Profile D. Banksia Low Scrub Woodland Community; on first ridge.

Horizon	Depth (cm)	General Description
A0		Very little litter.
A1	0-8	Grey sand with little organic matter pH 5.3.
	8-20	Light grey sand—becoming leached.
	20-152	Very leached white sand.
	152-177	Definately darkened layer of brown sand, which suggests slight tendency to form coffee rock.
	177-200	Yellow-brown clay streaked with blue at depth pH 5.2.

Profile E. *Eremaea Low* Scrub: first ridge.

Horizon	Depth (cm)	General Description
A0		Little litter.
A1	0-8	Mid-dark grey sand. pH 5.4.
	8-30	Light grey sand—showing transition to leached sand.
	30-165	Leached light grey to white sand.
	165-170	A dark brown layer of poorly formed coffee rock.
	170-180+	Brown-yellow clay. pH 5.3.

Profile F. *Actinostrobus* Community: along weak drainage line.

Horizon	Depth (cm)	General Description
A0		No litter.
A1	0-2.5	Very dark sedimentary layer—this is very low lying—represents a part of the very poorly defined drainage channel. pH 6.5.
	2.5-10	Grey sand, rapidly showing signs of leaching.
	10-35	White leached sand.
	35-60	Yellow-brown clay. pH 7.0.

Appendix II

Species List—Yule Brook Reserve

Note—Names in brackets are the names by which the species was formerly known.

PTERIDOPHYTA:

LYCOPODIACEAE:

Phylloglossum drummondii Kunze

SELAGINELLACEAE:

Selaginella gracillima (Kunze) Alston

ISOETACEAE:

Isoetes drummondii R.Br.

GYMNOSPERMAE:

ZAMIACEAEA:

Macrozamia riedlei (Gaud.) Gardn.

CUPRESSACEAE:

Actinostrobus pyramidalis Miq.

ANGIOSPERMAE—MONOCOTYLEDONEAE:

CENTROLEPIDACEAE:

Aphelia cyperoides R.Br.
A. drummondii (Hieron.) Benth.
Centrolepis aristata (R.Br.) Roem et Schultes
C. glabra (F. Muell.) Hieron.
C. humilliama (F. Muell.) Benth.
C. polygyna (R.Br.) Hieron.
Desvauxia drummondiana Nees (*C. drummondii* (Nees) Hieron).

CYPERACEAE:

Cyathochaeta avanacea (R.Br.) Benth.
Cyperus tenellus L.f.
Gahnia trifida Labill.
Isolepis marginata (Thunb) A.Dietr. (*Scirpus antarcticus* L.)
Lepidosperma angustatum R.Br.
L. resinosum (Nees) Benth.
Mesomelaena stygia (R.Br.) Nees
M. tetragona (R.Br.) Benth.
Schoenus andrewsii W.V. Fitzg.
S. asperocarpus F. Muell.
S. benthami F. Muell.
S. brevifolius R.Br.
S. curvifolius (R.Br.) Benth.
S. jamesonianus W.V. Fitzg.
S. nanus (Nees) Benth.
S. pedicellatus (R.Br.) Benth.
S. rigens (S.T.) Blake.
S. trachycarpus F. Muell.
Tetrariapsis octandra (Nees) Kuekenthal

HAEMODORACEAE:

Anigozanthos bicolor Endl.
A. humilis Lindl.
A. manglesii D. Don
A. viridis Endl.
Conostylis aculeata R.Br. ssp *preissii* (Endl.) J. W. Green
C. aurea Lindl.
C. candicans Endl.
C. filifolia F. Muell.
C. juncea Endl. (*C. involucrata* Endl.)
C. setigera R.Br.
Haemadorum brevisepalum Lindl.
H. paniculatum Lindl.
H. simplex Lindl.
H. spicatum Rr.Br.
Phlebocarya ciliata R.Br.
Tribonanthes brachypetala Lindl.
T. uniflora Lindl.
T. variabilis Lindl.

HYPOXIDACEAE:

Hypoxis occidentalis

IRIDACEAE:

Orthrosanthus laxus (Endl.) Benth.
Patersonia juncea Lindl.
P. occidentalis R.Br.
P. umbrosa Endl.

JUNCACEAE:

Juncus bufonius L.
J. capitatus Weig.
J. pallidus R.Br.

JUNCAGINACEAE:

Triglochin calcitrapa Hook.
T. centrocarpa Hook.
T. minutissima F. Muell.
T. mucronata R.Br.
T. procera R.Br.
T. stowardii N. E. Brown

LILIACEAE:

Agrostocrinum scabrum (R.Br.) Baill.
Arnocrinum preissii Lehm.
Arthropodium preissii Endl.
Borya scirpoidea Lindl.
Burchardia multiflora Lindl.
B. umbellata R.Br.
Burchardia sp.
Chamaescilla corymbosa (R.Br.) F. Muell.
Johnsonia lupulina R.Br.
J. pubescens Lindl.
Laxmannia ramosa Lindl.
L. sessiflora Dene.
L. squarrosa Lindl.
Sowerbaea laxiflora Lindl.
Thysanotus dichotomus (Labill.) R.Br.
T. multiflorus R.Br.
T. patersonii R.Br.
T. scaber Endl.
T. sparteus Lindl.
T. thyrsoideus Baker
T. triandrus (Labill.) R.Br.
Wurmbea dioica (R.Br.) F. Muell.

ORCHIDACEAE:

Caladenia deformis R.Br.
C. discoidea Lindl.
C. flava R.Br.
C. gemmata Lindl.
C. hirta Lindl.
C. huegelii Reichb. f.
C. macrostylis W.V. Fitzg.
C. marginata W.V. Fitzg.
C. patersonii R.Br.
C. sericea Lindl.
Diuris laxiflora Lindl.
D. longifolia R.Br.
D. purdici Diels
Elythranthera brunonis (Endl.) A. S. George
Leporella fimbriata (Lindl.) A. S. George
Lyperanthus nigricans R.Br.
Microtis atrata Lindl.
Paracaleana nigrita (Lindl.) Blaxell
Prasophylum cyphochilum Benth.
P. hians Reichb. f.
P. drummondii Reich. f.
P. macrostachyum R.Br.
P. ovale Lindl.
P. parvifolium Lindl.
Pterostylis nana R.Br.
P. vittata Lindl.
Thelymitra antennifera (Lindl.) Hook. f.
T. flexuosa Endl.

PHILYDRACEAE:

Philydrella pygmaea (F. Muell.) Car. (*Pritzelia pygmaea* (R.Br.) F. Muell.)

POACEAE:

Amphipogon turbinatus R.Br.
Danthonia occidentalis J. Vickery
Neurachne alopecuroidea R.Br.
Polypogon tenellus R.Br.
Sporobolus virginicus (L.) Kunth.
Stipa compressa R.Br.
S. hemipogon Benth.
S. variabilis Hughes

RESTIONACEAE:

Anarthria gracilis R.Br.
A. laevis R.Br.
Hypolaena exsulca R.Br.
Lepidobolus preissianus Nees
Leptocarpus aristatus R.Br.
L. canus Nees
L. coangustatus Nees
Lepyrodia macra Nees
Loxocarya fasciculata (R.Br.) Benth.
L. flexuosa (R.Br.) Benth.
L. pubescens (R.Br.) Benth.
Lyginia barbata (*L. tenax* (Labill.) Gardn.)
L. aff. barbata
Restio nitens Nees
R. sphacelatus R.Br.
R. tremulus R.Br.

XANTHORRHOEACEAE:

Acanthocarpus preissii Lehm.
Calectasia cyanea R.Br.
Dasypogon bromeliifolius R.Br.
Lomandra caespitosa (Benth.) Ewart
L. endlicheri (F. Muell.) Ewart
L. hermaphrodita (C. Andrews) C. A. Gardner
L. micrantha (Endl.) Ewart
L. preisii (Endl.) Ewart
Xanthorrhoea gracilis
X. preissii Endl.

ANGIOSPERMAE—DICOTYLEDONAE:

AIZOACEAE:

Macarthuria australis Hueg.

AMARANTHACEAE:

Ptilotus drummondii (Moq.) F. Muell.

APIACEAE: (UMBRELLIFERAE)

Actinotus leucocephalus Benth.
Eryngium pinnatifidum Bunge
Homalosciadium homalocarpum (F. M. Muell.) H. J. Eichler
Hydrocotyl callicarpa Bunge
Schoenolaena tennior Bunge
Trachymene pilosa Sm.
Xanthosia huegelii (Benth.) Steud.

ASTERACEAE: (COMPOSITAE)
Angianthus pygmaeus (A. Grey) Benth.
A. strictus (Steetz.)Benth.
A. tenellus (F. Muell.) Benth.
Brachycome pusilla Steetz
Chrysocoryne drummondii A. Gray
Cotula coronopifolia L.
C...pratense
Craspedia uniflora G. Forster
Helichrysum bracteatum (Vent.) Andr.
Helipterum cotula (Benth.) DC.
Isoetopsis grammifolia Turcz.
Lagenifera hmegelii Benth.
Olearia sp.
Podolepis gracilis R.Grah.
P. nutans Steetz
Podotheca angustifolia (Labill.) Less.
P. chrysantha (Steetz) Benth.
P. gnaphaloides Grah.
Quinetia urvillei Cass.
Siloxerus filifolius (Benth.) Ostenf. (*Angianthus filifolius (Benth.)* C.A. Gardn.)
S. humifusus Labill. (*A. humifusus* (Labill.) Benth.)
Trichocline sp.
Waitzia paniculata (Steetz) F. Muell. ex Benth.

BYBLIDACEAE:
Byblis gigantea Lindl.

CALLITRICHACEAE:
Callitriche stagnalis Scop.

CASUARINACEAE:
Casuarina fraseriana Miq.
C. humilis Otto et Dietr.

CHENOPODIACEAE:
Halosarcia halocnemoides (Nees) P. G. Wilson, comb. nov. (*Arthrocnemum halocnemoides* Nees)

CLOANTHACEAE: (VERBENACEAE)
Pityrodia uncinata (Turcz.) Benth.

CONVOLVULACEAE:
Cuscuta epithymum L.
Wilsonia backhousii Hook.

CRASSULACEAE:
Crassula colorata (Nees)Ostf.
C. recurva (Hook. f.) Ostf.

DILLENIACEAE:
Hibbertia aurea Steud.
H. huegelii (Endl.) F. Muell.
H. hypericoides (DC.) Benth.
H. racemosa (Endl.) Gilg.
H. stellaris Endl.

DROSERACEAE:
Drosera bulbosa Hook.
D. erythrorhiza Lindl.
D. gigantea Lindl.
D. glanduligera Lehm.
D. heterophylla Lindl.
D. leucoblasta Benth.
D. macrantha Endl.
D. menziesii R.Br.
D. neesii Lehm.
D. occidentalis A. Morrison
D. palacea DC.
D. pallida Lindl.
D. stolonifera Endl.
D. zonaria Planch.

EPACRIDACEAE:
Andersonia aristata Lindl.
A. gracilis DC.
A. sprengelioides R.Br.
Astroloma pallidum R.Br.
A. stomarrhena Sond.
Conostephium pendulum Benth.
Leucopogon conostephioides DC.
L. oxycedrus Sond.
L. polymorphus Sond.
L. propinquus R.Br.
L. pulchellus Sond.
L. racemulosus DC.
L. squarrosus Benth.
Lysinema ciliatum R.Br.
Needhamiella pumilio (R.Br.) L. Watson

EUPHORBIACEAE:
Monotaxis grandiflora Endl.
Phyllanthus calycinus Labill.
Poranthera microphylla Brongn.

FABACEAE: (PAPILIONACEAE)
Bossiaea eriocarpa Benth.
Burtonia conferta DC.
Daviesia incrassata Sm.
Dillwynia cinerascens R.Br.
Eutaxia virgata Benth.
Gompholobium tomentosum Labill.
Hovea trisperma Benth.
Isotropis cuneifolia (Sm.) Benth. ex B. D. Jackson
Jacksonia floribunda Endl.
J. furcellata (Bonpl.) DC.
J. lehmannii Meisn.
J. sternbergiana Hueg.
Kennedya prostrata R.Br.
Oxylobium capitatum Benth.
Sphaerolobium medium R.Br.
Viminaria juncea (Schrad & Wendl.) Hoffmans.

GENTIANACEAE:
Villarsia albiflora F. Muell.

GOODENIACEAE:
Anthotium humile R.Br.
Dampiera linearis R.Br.
Goodenia caerulea R.Br.
G. filiformis R.Br.
Lechenaultia expansa R.Br.
Scaevola canescens Benth.
S. longifolia De Vries
S. paludosa R.Br.
Velleia trinervis Labill.

HALORAGACEAE:
Gonocarpus pithyoides Nees (*Haloragis pithyoides* (Nees) Benth.)

LAMIACEAE:
Hemiandra pungens R.Br.

LAURACEAE:
Cassytha flava Nees
C. micrantha Meisn.

LENTIBULARIACEAE:
Polypompholyx multifida (R.Br.) F. Muell.
P. tenella (R.Br.) Lehm.
Utricularia inaequalis A.DC. (*U. hookeri* Lehm.)
U. menziesii R.Br.
U. violacea R.Br.

LOBELIACEAE:
Isotoma hypocrateriformis (R.Br.) Druce
I. pusilla Benth.
Lobelia alata Thunb.
L. gibbosa Labill.
L. temior R.Br.
Monopsis simplex (L.) E. Wimm.

LOGANIACEAE:
Mitrasacme paradoxa R.Br.

LORANTHACEAE:
Nuytsia floribunda (Labill.) R.Br.

MALVACEAE:
Selenothammus squamatus (Nees) Melville (*Plagianthus squamatas* (Nees) Benth.)

MIMOSACEAE:
Acacia huegelii Benth.
A. pulchella R.Br.
A. saligna Wendl. (*A. cyanophylla* Lindl.)
A. stenoptera Benth.
A. lasiocarpa Benth.

MYRTACEAE:
Astartea fascicularis (Labill.) DC
Baeckea camphorosmae Endl.
Beaufortia squarrosa Schau.
Calothamnus lateralis Lindl.
C. aff. villosus R.Br.
Calytrix aurea Lindl.
C. flavescens A. Cunn.
C. fraseri A. Cunn.
Aremaea pauciflora (Endl.) Druce
Eucalyptus calophylla R.Br.
E. rudis Endl.
Hypocalymma angustifolium Endl.
H. robustum Endl.
Kunzea micrantha Schau.
K. vestita Schau. (*K. ericifolia Reichb.*)
Leptospermum ellipticum Endl.
Melaleuca bracteosa Turcz. (*M. fasciculiflora* Benth.)
M. hamulosa Turcz.
M. lateriflora Benth.
M. lateritia A. Dietr.
M. preissiana Schau. (*M. parviflora* Lindl.)
M. rhaphiophylla Schau.
M. scabra R.Br.
M. seriata Lindl.
M. uncinata R.Br.
M. viminea Lindl.
Regelia ciliata Schau.
Scholtzia involucrata (Endl.) Druce
Verticordia acerosa Lindl.
V. densiflora Lindl.
V. drummondii Schau.
V. huegelii Endl.
V. lindleyi Schau.
V. plumosa (Desf.) Domin.

POLYGALACEAE:
Comesperma virgatum Labill.

PORTULACEAE:
Calandrinia corrigioloides (F. Muell.) Benth.
C. granulifera Benth. (*C. pygmaea* F. Muell.)

PRIMULACEAE:
Samolus junceus R.Br.

PROTEACEAE:
Adenanthos cygnorum Diels
Banksia attenuata R.Br.
B. grandis Willd.
B. ilicifolia R.Br.
B. littoralis R.Br.
B. menziesii R.Br.
B. telmatiaea A. S. George
Conospermum huegelii R.Br.
C. stoechadis Endl.
C. triplinervium R.Br.
Dryandra nivea (Labill.) R.Br.
Grevillea thelemanniana Hueg.
Hakea candolleana Meisn.
H. ceratophylla (Sm.) R.Br.
H. prostrata R.Br.
H. sulcata R.Br.
H. varia R.Br.
Persoonia augustiflora Benth.
P. saccata R.Br.
Petrophile linearis R.Br.
P. longifolia R.Br.
P. macrostachya R.Br.
P. media R.Br.
P. seminuda Lindl.
Stirlingia latifolia (R.Br.) Steud.
S. simplex Lindl.
Synaphea petiolaris R.Br.
S. spinulosa (Burm. an.) *Merrill* (*S. polymorpha* R.Br.)

RUBIACEAE:
Opercularia vaginata Labill.

RUTACEAE:
Boronia viminea Lindl.
Eriostemon spicatus A. Rich.

SANTALACEAE:
Leptomeria empetriformis Miq.

SAPINDACEAE:
Dodonaea ceratocarpa Endl.

STACKHOUSIACEAE:
Stackhousia brunonis Benth.
S. huegelii Endl.

STYLIDIACEAE:
Levenhookia preissii (Sond.) F. Muell.
Stylidium amoenum R.Br.
S. brunonianum Benth.
S. bulbifera Benth.
S. calcaratum R.Br.
S. canaliculatum Lindl.
S. carnosum Benth.
S. dichotomum DC.
S. diuroides Lindl.
S. divaricatum Sond.
S. ecorne (F. Muell ex Erickson & Willis) comb & status nov.
S. guttatum R.Br.
S. inundatum R.Br.
E. obtusatum Sond.
S. perpusillum Hook. f.
S. petiolare Sond.
S. piliferum R.Br.
S. pulchellum Sond.
S. repens R.Br.
S. roseo-alatum Erickson & Willis
S. schoenoides DC.
S. striatum Lindl.
S. utricularioides Benth.

THYMELAEACEAE:
Pimelea imbricata R.Br. var. gracillima Meisn.
P. sulphurea Meisn.